REMARKS

In response to the Examiner's request, a Form 1449 is submitted identifying the Lin et al. paper that was submitted with the Amendment of February 7, 2003.

In the Office Action mailed April 7, 2003:

Claims 24, 25, 30-32 were rejected under 35 U.S.C. 102(e) as being anticipated by Gartstein et al. (U.S. Pat. 6,379,324).

Claims 26, 27, 33 and 34 were rejected under 35 U.S.C. 103(a) as being unpatentable over Gartstein.

Claims 28 and 29 were rejected under 35 U.S.C. 103(a) as being unpatentable over Gartstein in view of Lin et al. (U.S. Pat. 5,591,139).

Applicants' invention is a microlancet made of an elongated single crystal silicon substrate that terminates in a sharp point at the penetration end and has a smooth continuous cutting profile for piercing and penetrating the skin. Preferably, the penetration end extends laterally from a base portion as shown in Fig. 1 I.

Gartstein discloses the fabrication of an array of hollow or solid microneedles from a silicon wafer using deep reactive ion etching (DRIE). As best shown in Gartstein's Fig. 22, the microneedles extend upwards perpendicular to the plane of the wafer. These microneedles are typically a few tens of micrometers in length, and are fabricated and used in arrays to permit handling and skin penetration. As can be seen in Figure 29, the needles are very sharp, and there is a relatively abrupt transition between the silicon wafer base and the side of the microneedle. As is suggested by the fabrication process illustrated in Figs. 18-21, Gartstein's microneedles are also very delicate. The diameter of the center bore or through-hole 460 is in the range of 5-10 microns (Col 16, line 24). And while the outer diameter D41 of the needle and the thickness of the needle walls are not specified, the thickness of the walls is illustrated as being comparable to the diameter of the bore.

While Gartstein states at Col 17, lines 8-12, that any needle diameter or length of microneedle could be fabricated to accommodate a particular skin structure, he is referring to microneedles that "would typically be no longer than two hundred (200) microns though they must typically be at least fifty (50) microns in length." (Col. 17, lines 15-17) Further, Gartstein specifies that "it is preferred that the microneedle penetrate through the stratum corneum to the epidermis, but not penetrate into the dermis itself" (Col. 17, lines 12-14). A

200 micrometer needle is long enough to penetrate the epidermis for most skin structures. Further, the length of the microneedle is ultimately limited by the thickness of the silicon wafer. Deep reactive ion etchers are designed to use standard commercially available silicon wafers, which are available in thicknesses of approximately 770 micrometers or less, and are most typically 500 micrometers thick. Figure 22 shows the relative height of Gartstein's microneedle array to the silicon wafer semiconductor substrate. Clearly, Gartstein did not anticipate a silicon lancet 1000-3000 micrometers (1-3 millimeters) in length.

In contrast to Gartstein, the width and length dimensions of applicants' solid silicon lancet are in the plane of the silicon wafer, permitting flexibility and accurate control of the lancet shape. Finite element analysis was used to design lancet dimensions which maximize strength while minimizing tissue displacement. The width can be tapered at any desired rate and the rate of taper can be varied over the length of the penetration end. The junction of the penetration member to the base can be rounded to minimize stress. Unlike Gartstein, the thickness of the penetration portion of the lancet can be thinned independently of its width, thus minimizing bulk and tissue displacement while retaining full wafer thickness at the lancet base for ease of handling. For example, a 50 micrometer by 200 micrometer cross section produces a tissue area displacement of 10,000 square micrometers with applicants' lancet. The equivalent displacement for the Gartstein microneedle 200 micrometers in diameter is 21,416 square micrometers - twice as great.

To emphasize these differences between applicants' invention and Gartstein, new Claims 35-41 have been added. Dependent Claim 35 defines over Gartstein in specifying that the microlancet has a penetration portion that extends laterally from the base portion in the silicon substrate. Independent Claim 36 has a similar limitation and is believed patentable for the same reason. Dependent Claim 37 is patentable for the same reason Claim 36 is patentable.

Independent Claim 38 specifies that the length of the penetration end be from about 1 millimeter to 3 millimeters. Claim 37 is believed patentable because Gartstein does not suggest a needle having such dimensions and indeed teaches away from such a needle. Dependent Claims 39-41 are patentable for the same reason Claim 38 is patentable

With respect to Claim 24, applicants have prepared a Declaration under 37CFR 1.131 from Wilson Smart, one of the inventors of the present application. An unsigned copy of this

Declaration is enclosed. A signed copy will be forwarded shortly. The Declaration provides copies of excerpts from two reports dated prior to 1999 on research performed under a contract with the Defense Advanced Research Projects Agency. The reports describe the microneedles that are the subject of the claims of this application and provide copies of photographs of these microneedles. Specifically, the reports and photographs describe microneedles made in single crystal silicon at Kumetrix in the United States prior to 1999 that have a penetration end and a base end. Further, some of the microneedles that were made had a tapered penetration portion. The reports therefore establish reduction to practice of applicants' invention as recited in Claim 24 prior to the June 9, 1999, filing date of the Gartstein reference.

Dependent Claims 25 and 32, are believed patentable because they explicitly recite a tapered penetration portion. Dependent Claims 26, 31, 33 and 34 are believed patentable because they recite specific dimensions or shapes of the penetration portion not disclosed by Gartstein. Dependent Claim 27 is believed patentable because it specifies that the length of the microneedle is from about 1 millimeter to about 3 millimeters. In contrast, Gartstein's needles are no more than 200 micrometers in length. Claims 28 and 29 are believed patentable because they specify that at least part of the base portion is covered by a silicon nitride film. Claim 30 is patentable because it specifies that the device is disposable.

In view of the foregoing, applicants believe that all of the claims are now in condition for allowance and respectfully requests the Examiner to pass the subject application to issue. If for any reason the Examiner believes any of the claims are not in condition for allowance, he is encouraged to phone the undersigned at (650) 849-7777 so that any remaining issues may be resolved.

Aside from the fees for Petition to Extend Time, no additional fee is believed due for filing this response. However, if a fee is due, please charge such fee to Pennie & Edmonds LLP's Deposit account No. 16-1150.

Respectfully submitted,

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